

EXPLOSIVES & WEAPONS DETECTION



National Defense Industrial Association Entry Point Screening

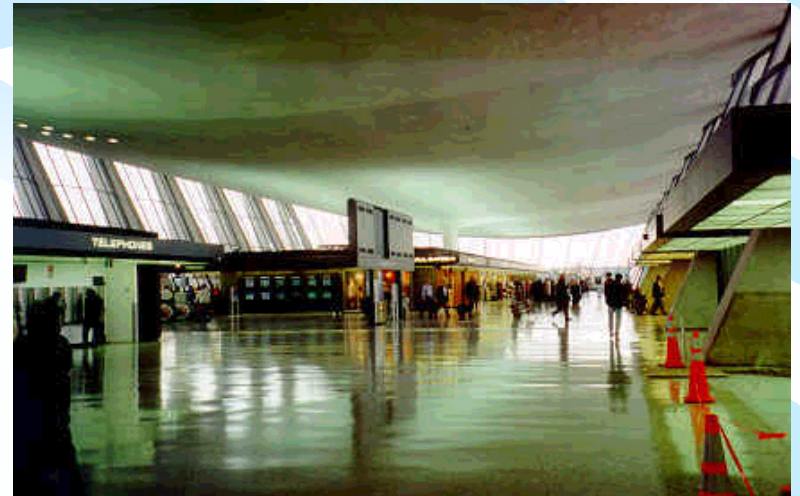
June 26, 2002

LEE SPANIER

**Transportation Security Laboratory
Office of Security Technology**



PROTECTING OUR AVIATION SYSTEM





CHARTER

**Develop secure, cost-effective,
customer- and screener-friendly
end state**

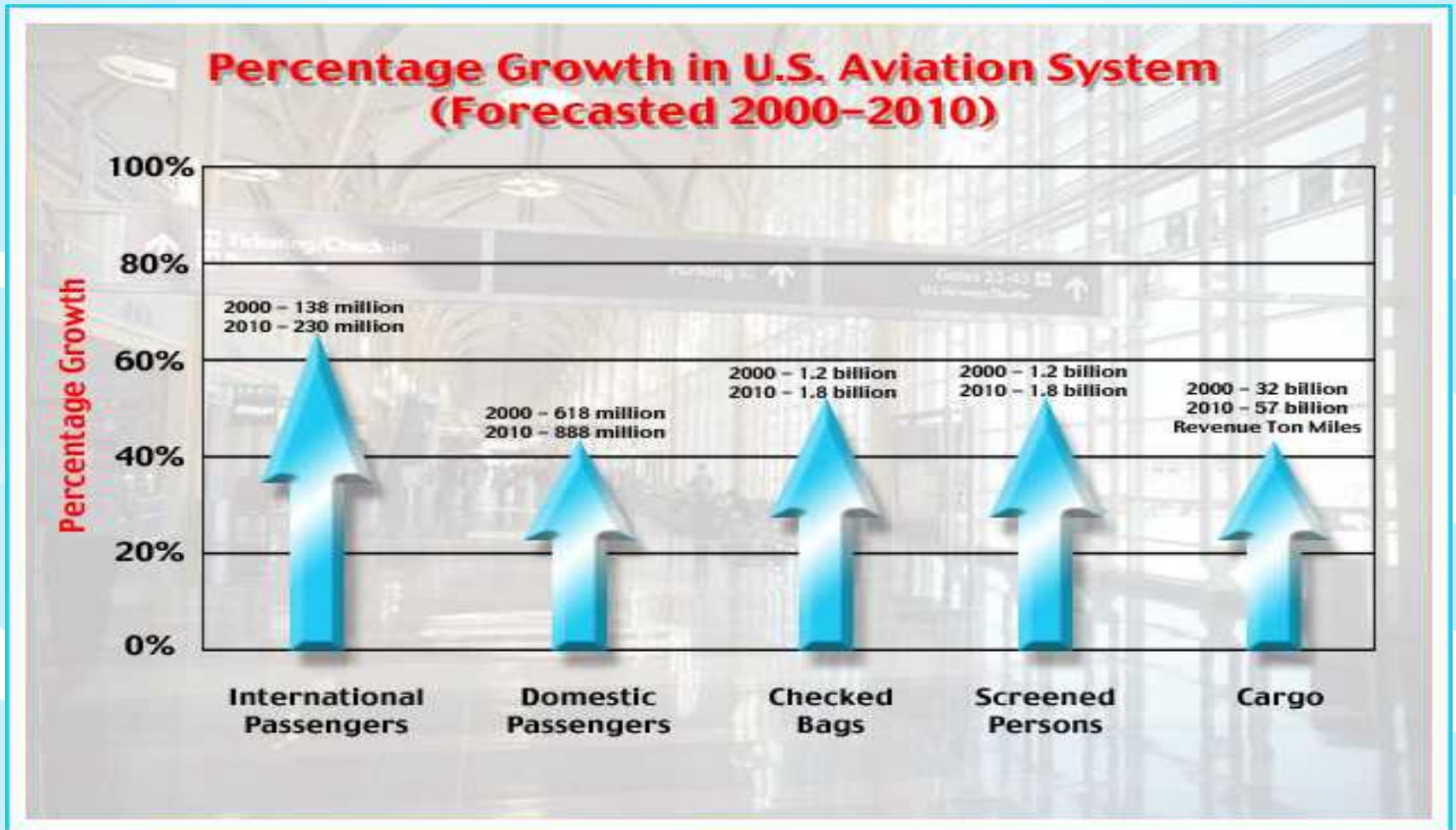


SECURITY CHALLENGE

- ❖ **454 U.S. Airports and 97 U.S. Air Carriers**
- ❖ **Over 650M annual passenger enplanements**
 - **1.4B pieces of checked luggage**
 - **4% annual increase - expect 800M by 2006**
- ❖ **Highly concentrated hub and spoke system**
 - **16 of world's 25 busiest airports**
 - **Connection times under 25 minutes**
 - **98% of all U.S. passengers pass through one of the 50 busiest hubs**
- ❖ **1,600 screening checkpoints (and growing!)**



PROJECTED SYSTEM GROWTH (2000 - 2010)





And if that wasn't enough...

(9/11/01 Aftermath)

- ❖ **Establishment of the Transportation Security Administration (TSA)**
- ❖ **Deployment mandates due to Aviation & Transportation Security Act (ATSA)**
- ❖ **TSA is responsible for security of all modes - not just aviation**

Today - Aviation Security matters only!



AIRCRAFT-CENTRIC APPROACH

- ❖ **Base requirements & standards on aircraft vulnerability**
- ❖ **Assess aircraft vulnerability**
 - Control systems, Airframe, Effects of pressurization, Explosives in checked & **carry-on bags**, Narrow & wide body aircraft
- ❖ **Identify all possible paths to aircraft**
 - Checked Bag, **Passengers & Carry-on bags (Checkpoint)**, Cargo & Mail, Airport (intruders), **Crew, Services**



APPROACH

❖ Screening

- Procedures (including alarm resolution protocols)
- Detection of threats

❖ Mitigation

- Aircraft hardening
- Hardened containers
- Cockpit door hardening
- Least risk locations



THREAT

- ❖ **Guns**
- ❖ **Knives**
- ❖ **Improvised explosive devices (IEDs)**
 - **Explosive charge, Power source, Detonator, Timing Device**
 - **Small and well concealed**
- ❖ **Chemical/ Biological/ Radiological/ Nuclear Devices (to a lesser extent)**



CBRN THREAT

❖ Aviation & Transportation Security Act

- Sec 110 : Strengthen and enhance the ability to detect or neutralize non-explosive weapons
- Sec 112: Review the potential release of biological, chemical, or similar substances within aircraft and airports

❖ TSA effort to address CBRN threat

- Establishing requirements and standards
- Interagency working groups, collaborative efforts with industry



EXPLOSIVES DETECTION METHODS

❖ BULK

- Tangible - detect visible amounts
- Automated detection of all IED components
- If bulk explosives present, so is threat
- Use nonintrusive/non-destructive probing radiation

❖ TRACE

- Non-tangible - detect invisible amounts
- Automated detection of explosive charge & possibly detonator
- If traces present, you MAY have a threat
- Use chemical detection methods



THREAT VECTORS

- ❖ **Checkpoint**
- ❖ Checked Baggage
- ❖ Cargo & Mail
- ❖ Airport





CHALLENGE

❖ Screening people and carry-on items for:

- Metallic weapons
- Non-metallic weapons
- Explosives
- Chemical & Biological agents

❖ Maintaining passenger flow

- Screening Duration
- Throughput
- Resolving false positives

❖ Upholding the 4th Amendment

- Human Dignity
- Privacy



SCREENING PEOPLE

Operational Requirements

- ❖ **Detect disassembled weapons**
- ❖ **Maintain passenger-bag visibility tether**
- ❖ **Ensure compatibility with personal medical electronic devices**
- ❖ **Minimize physical contact with screening device and screener**
- ❖ **Provide for automated collection and transmission of screener performance data**



ATSA & CHECKPOINT

- ❖ **Critical elements of a checkpoint:**
 - **Equipment**
 - **Screeners**
- ❖ **ATSA Sec 111: Establish security screener hiring qualification standards requiring satisfactory exam score, U.S. citizenship, specified education skills & abilities, etc.**
- ❖ **ATSA Sec 122: Restrict carry-on baggage to one bag & one personal item**



EQUIPMENT

- ❖ **Walk-through metal detectors (WTMD)**
- ❖ **Hand-held metal detectors (HHMD)**
- ❖ **Explosive trace detectors (ETD)**
- ❖ **X-Ray**
 - **Threat Image Projection (TIP)-ready x-ray systems (TRX)**
 - **Conventional cabinet X-Rays**



METAL DETECTION

❖ WTMD

- High throughput devices
- TSA calibration standard - revised to include expanded threat set, location function, higher detection requirement & manageable nuisance alarm rate
- Revised qualified vendors list to be developed

❖ HHMD

- Primarily used as a WTMD alarm resolution tool
- TSA calibration standard being developed to establish qualified vendors list



EXPLOSIVE TRACE DETECTORS

- ❖ Can detect & identify microscopic amounts of explosive material
- ❖ Used for detection of the explosive component of an IED
- ❖ Used in conjunction with X-Ray and physical search to provide an additional layer of security
- ❖ ETD alarm does not necessarily mean there is an IED in the bag
 - Pax carrying certain medications
 - Pax with legitimate reasons to handle explosives



ETD DEVICES & EFFICACY

- ❖ **Currently, three manufacturers and six models available for security screening**
- ❖ **Manufacturers:**
 - **Barringer Instruments**
 - **IonTrack Instruments**
 - **ThermoDetection**
- ❖ **Selection of approved models based on laboratory and operational tests**
- ❖ **Efficacy highly dependent on screener performance**



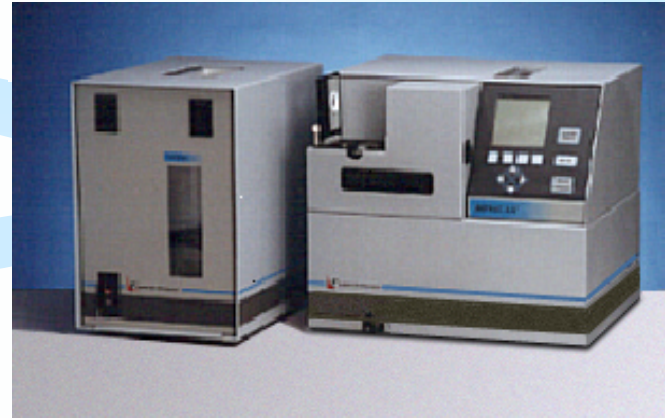
ETD - BARRINGER

❖ Technology:

- Ion Mobility Spectrometry

❖ Approved models:

- IonScan Models 400 and 400B





ETD - IONTRACK

❖ Technology:

- Ion Mobility Spectrometry

❖ Approved models:

- Itemizer-DOS & Itemizer-W





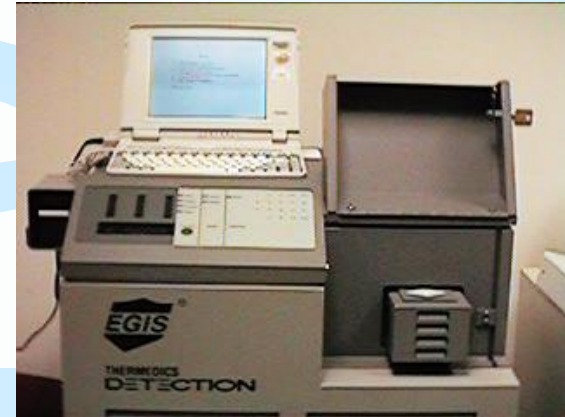
ETD - THERMODETECTION

❖ Technology:

- GC/Chemiluminescence

❖ Approved models:

- EGIS Models 3000 & II





ETD DEPLOYMENT



- ❖ **Over 1200 devices deployed at airports today for checkpoint and checked baggage screening**



X-RAY MACHINES

- ❖ **Detect NOTHING**
- ❖ **Simply image items, screener must interpret image to make decision on presence of threat and need for further screening**
- ❖ **Efficacy highly dependent on screener performance**
 - **TRX machines can be used for training, testing, and keeping screeners alert**



SCREENER PERFORMANCE

❖ Pre-ATSA

- Screener workforce minimally trained, high turnover rate, low morale, salary and poor benefits

❖ Post-ATSA

- Federal screener workforce, better-trained, highly motivated, improved salary and benefits package
- Continued TRX deployment



SCREENER PERFORMANCE

- ❖ **Threat Image Projection (TIP)**
- ❖ **Computer-Based Training (CBT)**
- ❖ **Screener Selection Test**
- ❖ **Screener Readiness Test**
- ❖ **On-the-Job Mastery Test**



THREAT IMAGE PROJECTION



- ❖ **Goal - To increase screener vigilance and knowledge of threats**
- ❖ **TIP overlays a digital threat on x-ray images**
- ❖ **TIP threat images are presented at random**
- ❖ **TRX machines can record screener response**



TIP LIBRARY

- ❖ **Standard library ensures even playing field**
- ❖ **TIP threats include guns, knives & IEDs**
- ❖ **Images vary in difficulty**
- ❖ **Images include entire bags & threats only**
- ❖ **TIP library developed with international cooperation**
- ❖ **New threats are easily added to the library**



TIP/TRX BENEFITS

- ❖ Increase vigilance by increasing expectation of encountering a threat
- ❖ Increase motivation by rewarding accurate identification of TIP image
- ❖ Improve training with immediate screener feedback & exposure to new threats
- ❖ Improve capability to identify screeners with low performance and problem images



TRX DEPLOYMENT

❖ Three manufacturers, eight models:

➤ Heimann

- Model 6040i & Model 7555i

➤ Rapiscan

- Model 520B & Model 522B

➤ Perkin Elmer

- Linescan 5, Linescan 110, Linescan 208, Linescan 237



❖ Almost 850 TRX machines deployed across the country to date



COMPUTER-BASED TRAINING

- ❖ Provides automated training
- ❖ Self-paced instruction
- ❖ Rigorous testing
- ❖ Extensive practice and exposure to sophisticated threats
- ❖ “Safe Passage” installed at some airports
- ❖ Screener training tools & procedures continue to be revised & updated



SCREENER TESTS

❖ Screener Selection Test

- Selection aid, provides an indication of aptitude for screening
- Includes hidden pattern test & X-ray image interpretation test

❖ Screener Readiness Test

- Includes text questions on policy & X-ray image interpretation test

❖ On-the-Job (OJT) Mastery Test

- Determines mastery of screener skills during OJT
- Includes X-ray image interpretation test



EMERGING TECHNOLOGIES

- ❖ **Trace screening of passengers**
 - Document screening
 - Trace portals
- ❖ **Bulk screening of passengers**
 - Basic Imaging technologies
 - Automated Imaging technologies
- ❖ **Long-term projects**
 - MEMS & Nano-sensors
 - Automated explosives detection systems for carry-on baggage



R&D Focus

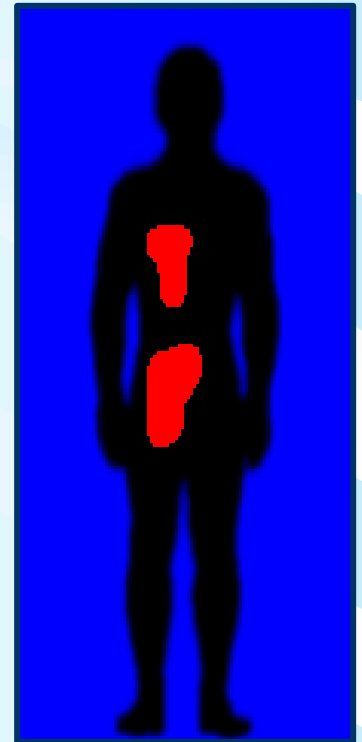


Future Technology – Personnel Screening Concealed Object Detectors

**Bulk detection – screening for artifacts
inconsistent with human physiology**

Legal and non-intrusive

Non-hazardous





Future Technology – Personnel Screening Trace Portals

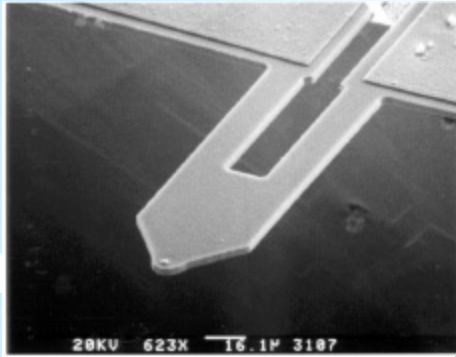


- ❖ Detection of trace explosive residue
- ❖ Potential use at security checkpoints in concert with metal detectors
- ❖ Full-body scan in ~15 s
- ❖ Presently, 3 systems being tested at FAA Technical Center



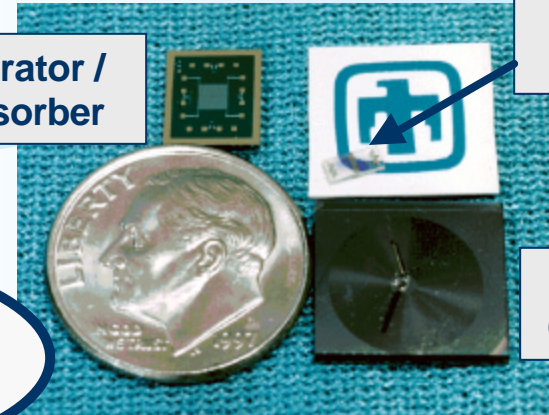
Future Trace Detection – Nanotechnology

Micro-cantilever



GC Based Micro-sensor

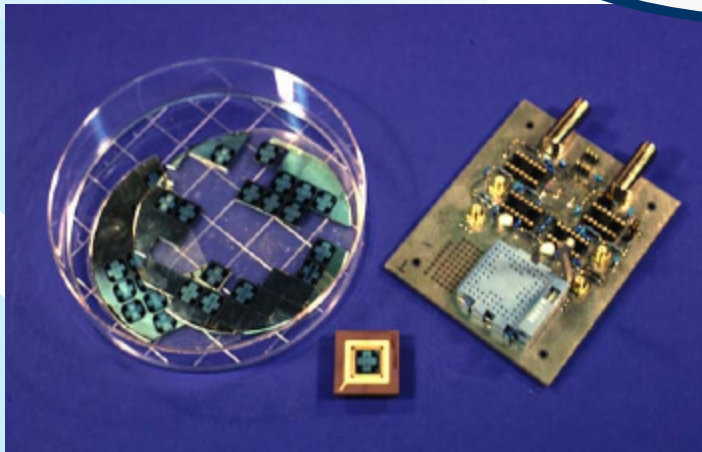
Pre-concentrator /
Thermal Desorber



4 SAW
Array

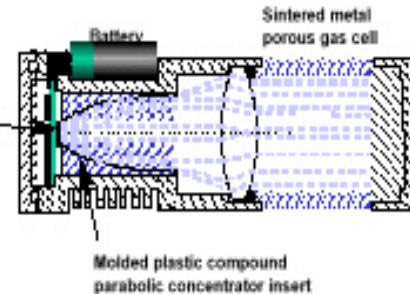
1-m GC
Column

*Expected Cost:
~\$20 each*



Liquid/Gas Sensor

Tuned infrared
transmit/receive
module IC

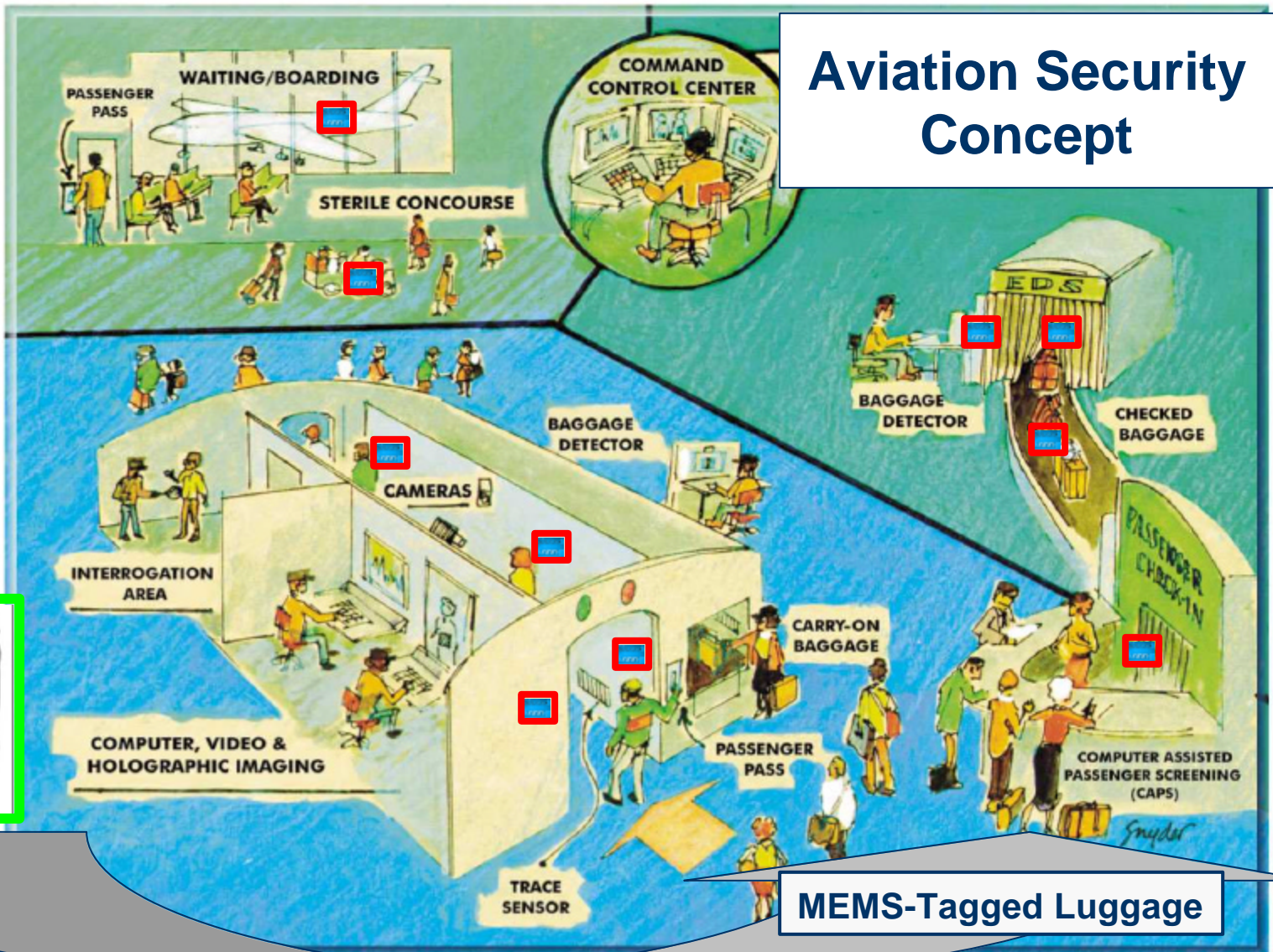


IR Based Gas Sensor³⁷



Aviation Security Concept

**MEMS
EDS/CW
Sniffer**



MEMS-Tagged Luggage



SCREENING CARRY- ON ITEMS

R & D Focus

- ❖ Threat Image Projection-Ready X-Ray systems (741 installed)



- ❖ Bench-top explosive trace detectors



- ❖ EDS- like automated detection devices





SUMMARY

- ❖ **Scope is large, and threat is real**
- ❖ **Screen for threat and provide for mitigation of effects of breach**
- ❖ **Emerging threats need new technologies**
 - **Current technologies provide advanced detection capabilities**
- ❖ **Balance growth demands and threat detection by combining technology innovations & procedural implementation**